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Item type	Article
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Citation	Theapleton, K. et al (2017) 'Virtually home: Exploring the potential of virtual reality to support patient discharge after stroke', British Journal of Occupational Therapy, 80(2) DOI 10.1177/0308022616657111
DOI	10.1177/0308022616657111
Journal	British Journal of Occupational Therapy
Downloaded	13-Jan-2019 02:54:29
Link to item	http://hdl.handle.net/10545/621379

Virtually home: Exploring the potential of virtual reality to support patient discharge after stroke

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Abstract

Introduction: The level of assessment and intervention received by patients prior to discharge varies widely across stroke services in the United Kingdom. This study aimed to explore the potential value of virtual reality in preparing patients for discharge following stroke.

Method: Semi-structured interviews were carried out with 13 occupational therapists, eight patients with a stroke and four community stroke survivors. Views were sought of the perceived acceptability, potential utility and limitations of a 'virtual home' environment for use in pre-discharge education and assessment. Data were analysed thematically.

Findings: Interviewees found the virtual home to be an acceptable and visual means of facilitating discussions about discharge. It was perceived as valuable in assessing patient insight into safety risks and exploring the implications of installing assistive equipment at home. Limitations were identified relating to specific software issues and the use of virtual reality with patients with cognitive or perceptual impairments.

Conclusion: The results demonstrate the potential utility of the virtual home within stroke rehabilitation. Patients and therapists engaged with the virtual home and, moreover, made practical suggestions for future development. Feasibility and pilot testing in a clinical setting is required to compare the use of the virtual home with traditional approaches of pre-discharge assessment.

Keywords Occupational therapy, virtual reality, stroke, rehabilitation, discharge planning

Introduction

Patient discharge from hospital after stroke in the United Kingdom (UK) is largely managed by occupational therapists. Currently, an established part of this process is the completion of pre-discharge home assessment visits ('home visits'), which are seen as a central role of the therapist (Chibnall, 2011). Although home visits are thought to enable patients to manage at home by supporting independence and safety (Lannin et al., 2007), there is limited evidence to demonstrate their effectiveness (Barras, 2005; Chibnall, 2011; Lockwood et al., 2015). The process of undertaking a home visit, for some patients, may also induce unnecessary anxiety that could potentially outweigh any benefits likely to be gained from the assessment (Mountain and Pighills, 2003).

Home visits are also relatively costly and time-consuming to complete, and there are no standardised criteria to govern the way in which they are carried out (Chibnall, 2011). Due to differing policies and resource limitations across UK stroke services, not every appropriate patient may receive a home visit after a stroke (Whitehead et al., 2014). More typically, discharge is managed by hospital based assessments and education for which there is a similar lack of standardised guidelines. As a result of these widespread variations, the level of assessment and intervention received prior to discharge differs widely across UK stroke services (Drummond et al., 2012).

The current process of patient discharge after stroke therefore has the potential to be improved and standardised. New approaches may offer solutions that are cost-effective as well as practical, and may prove particularly beneficial for patients who do not currently receive a home visit. One recent study, which compared patients who were given a home visit with a control group who were assessed in hospital using a therapist-led structured interview, found no significant difference in outcomes between the two groups (Drummond et

al., 2013). Although this was a feasibility trial and therefore underpowered, the findings indicate the potential value of structured ward-based interviews in preparing patients for discharge.

One approach that could be utilised to facilitate such ward-based discussions is the use of virtual reality (VR) and software applications. VR refers to systems or devices that allow users to interact with computer-generated environments, scenarios and objects (Saposnik et al., 2010). Within wider healthcare, there is some evidence for the use of VR in discharge planning. Atwall et al. (2013) examined the use of a three-dimensional interior design software package that enabled users to create an interactive virtual simulation of their own home. Although this was explored in the field of older adult care rather than stroke, therapists viewed the software as having the potential to support discharge planning by informing the need for assistive equipment and adaptations in the home, such as hoists and grab rails, and in helping patients to visualise the installation of these.

In relation to stroke care, however, this approach may be less feasible. Therapists would need to be able to obtain comprehensive information about the patient's home in order to replicate it with the software. Owing to the usually short timescale of discharge planning post stroke, this approach may prove too time-consuming and burdensome to be used as part of routine occupational therapy practice. An alternative could entail depicting virtual representations of various generic home environments, such as a bungalow, a flat and a two-storey house. While these may lack specificity to the individual, such representations could nonetheless be used to facilitate ongoing discussions, and highlight safety and practical issues relevant to patients returning home after stroke.

A VR application simulating the layout of a generic home environment has been developed for use within preregistration occupational therapy education (Sutton, 2011; Sutton et al., in press). This application was used to assess whether the 'virtual home' (VH) could facilitate the development of students' problem solving and clinical decision making skills necessary for conducting home visits. The VH simulated a generic layout of a bungalow with four rooms: a kitchen, living room, bathroom and bedroom, as shown in Figure 1 and Figure 2. Each room contained a range of furniture, fittings and household objects, as found in a typical home. In addition, the VH included examples of safety issues and challenges particularly relevant to patients following stroke; for example, access difficulties and potential safety risks, such as trip hazards (including rugs and wires) and overloaded electrical sockets.

This VH application has shown initial positive results, indicating proof of principle for this approach within education (Sutton et al., in press). There may therefore be further scope to develop the VH as a tool to support patients and carers in preparing for discharge after stroke. In particular, it could aid therapists in providing information about potential issues encountered after discharge and discussing how these might be managed. The VH may also be used to help prompt patients to recall details of their own home environment, including any aspects that could inform the assessment of individual needs. This may further aid the discussion of possible coping strategies, help to direct referrals to appropriate community services and highlight the need to practice with necessary assistive equipment.

As this VH application was originally designed as an educational tool, it is likely to require further modifications to both its design and content in order to be used specifically as a tool to support patient discharge. Prior to conducting such modifications, there is a need for initial exploratory work to determine whether this approach is appropriate for patients following stroke. The aim of this study was therefore to explore perceptions concerning the acceptability, potential utility and limitations of the use of the VH in this context, from the perspectives of both therapists and patients.

Figure 1. View of the living room.



Figure 2. View of the kitchen.



Methods

Design

Qualitative data were collected through semi-structured interviews, which are an established method for gaining an understanding of participants' views and perspectives (Astin and Long, 2009). Interviews were conducted with occupational therapists working in stroke services, hospital patients who had recently experienced a stroke and stroke survivors living in the community, with the aim of capturing a range of experiences.

Target sample sizes for interviews were 16 occupational therapists, eight hospital patients and six stroke survivors from a community setting. These targets were selected as an appropriate and manageable number for an exploratory study, in keeping with the resources and timescale available.

Separate interview topic guides were devised for the patient and therapist groups through discussions within the research team and steering group. These comprised both open questions and prompts exploring the overall acceptability of the VH application, as well as specific issues relating to its use in supporting patient discharge.

Procedure

Convenience sampling was employed to recruit band 5, 6 and 7 occupational therapists from two regional stroke units within the East Midlands. Therapists were invited to participate by means of an invitation letter asking for volunteers, accompanied by an information sheet explaining the aims of the interviews.

Hospital patients diagnosed with a stroke were recruited from one of the above stroke units by purposive sampling, designed to reflect patient variation in terms of home environment (for example, flat (apartment), house), family and care situations, and demographics (for example, age, gender). Patient interviewees were initially approached by a member of their usual care team, and an information sheet was given to eligible patients. Stroke survivors in the community were identified by convenience sampling from a regional patient and public involvement group for stroke related research. Participants who had experienced a stroke were excluded if they had epilepsy triggered by screen images, did not speak English, had a previous diagnosis of dementia, or were unable to follow a two-stage command.

All interviewees were given a demonstration of the VH application by the researcher at the start of the interview, and were then given the opportunity to try out the software independently. The VH was shown on a laptop with a 15.6 inch screen. Users were able to navigate and explore the VH by means of an avatar – a digital representation of themselves – controlled by a combination of a mouse and arrow keys. Therapist interviews took place in a private room on the hospital ward, patient interviews were completed by the bedside and other stroke survivors were interviewed in their own homes. All interviews were digitally recorded and transcribed verbatim.

Ethical considerations

Ethical approval was obtained from the research ethics committee (NRES Committee East Midlands – Leicester; REC Ref: 13/EM/0241). All participants provided written informed consent prior to participation.

Data analysis

Data were analysed by thematic analysis (Braun and Clarke, 2006). The data set was reviewed and coded by the main interviewer and independently reviewed by a second researcher and emerging themes were identified. A proportion of the coded transcripts and initial themes were then further reviewed by the wider research team for final agreement. Any disagreements relating to the codes or themes were discussed until consensus was achieved or a majority decision was taken. Refinement and checking of the themes by the first author took place on an ongoing basis throughout further stages of the study.

Results

Table 1 Characteristics of patients and stroke survivors

	Patients (n=8)	Stroke Survivors (n=4)
Mean age (SD)	68 years (24) Range 23-93 years	70 years (9) Range 65 – 78 years
Male/Female	2/6	2/2
Mean time since stroke onset (SD)	26 days (20) Range 5 – 58 days	6 years (6) Range 1-14 years
Ethnicity – White British	8 (100%)	4 (100%)
Living arrangements:		
House with stairs	6 (75%)	4 (100%)
Bungalow	2 (2%)	0 (0%)
Lives alone	4 (50%)	0 (0%)
Lives with partner/family	4 (50%)	4 (100%)
Mobility:		
Independent (incl. walking aids)	6 (75%)	3 75%)
Wheelchair dependent	2 (25%)	1 (25%)
No previous computer experience	4 (50%)	0 (0%)

Table 2 Emergent themes and subthemes from occupational therapist and patient groups

Occupational Therapist themes and subthemes
1 Potential Utility of VH application
a) Potential for patients and care giver education
b) Potential for patient screening/assessment
2 Issues with the use of the VH application within Stroke
a) Patient centred issues
b) Resource based issues
c) Potential threat to practice
3 Modifications and Usability
Patient and Stroke survivor themes and subthemes
1 Patient engagement
2 Modification and usability

Thirteen occupational therapists were recruited. All had clinical experience of conducting home visits and/or access visits. Six of the therapists worked on acute stroke wards and seven worked on stroke rehabilitation wards. A total of 12 patients was recruited: eight hospital patients diagnosed with a stroke and four stroke survivors in the community. Patient and stroke survivor characteristics are presented in Table 1.

Occupational therapist interview findings

The emergent themes and sub-themes from the analysis of the therapist interviews are described below, accompanied by example quotations, and are summarised in Table 2.

Theme 1: Potential utility of the VH application. Therapists thought the VH could serve two potential functions as part of discharge planning practice: firstly for patient and carer educational and secondly as a screening/assessment tool.

Potential for patient and carer education:

Therapists felt that the VH could serve as a visual aid to direct and facilitate discussions regarding discharge.

"It's a good way of visualising, it's always more helpful than someone explaining to you". (OT1)

It was felt that the visual cues from the VH may prompt the patient's or family members' memories when discussing details of their home environment.

"It might prompt them or remind them, 'Oh we do have the ironing board there and maybe we can move that'. So it could definitely be used as an educational tool and more of a prompt for our initial interview that we do with family, just to make sure we are not missing anything, because it is amazing what families forget to tell us" (OT9)

It was felt that utilising the VH may engage and empower the patients during this process to get them 'thinking about home'. (OT9)

"Use it as a tool to, you know, talk through with them about how their layout is compared to this, and have they thought about things maybe at the point of starting to think about home as kind of a precursor, and something to help engage them and give them a bit of ownership of looking towards home". (OT5)

This could then help patients and families to understand and identify any modifications that may be required at home, such as aids and adaptations, improving access, or addressing safety concerns. The VH was also perceived to be a useful way of visualising the logistics of fitting, moving and storing assistive equipment at home.

"I always think that the family don't always really understand the amount of space that things may require . . . it makes people realise that actually that dresser needs to move, that sofa can't be there." (OT1)

It was also suggested that the VH could help patients to understand how and why therapists make certain, potentially difficult, decisions regarding their discharge.

"Maybe you're thinking, 'Actually you're never going to be getting home because of a, b and c', so you could use this to help them come to that decision with you and understand why you're making that decision." (OT13)

Potential for patient screening/assessment:

Therapists thought that the VH could be utilised to facilitate assessments of patients' safety awareness and insight:

"I think it would be useful if you were worried about their safety awareness or insight, to say that, 'Well, look, find five dangers in this room". (OT13)

"They could look around and find hazards and it would give you a talking point to discuss what they had seen and what they had not seen". (OT7)

Therapists felt it would also be useful to create interactive scenarios in the VH; for example, someone knocking at the door, and then to ask the patient how they would respond. They could then discuss how further to identify complex safety risks at home, the potential consequences of these risks and how they might be managed.

"For example, that lady tripped over the rug and you could see the cause and effect. You could show, you know, the gas fire being left on, and the potential risk and safety implications of those." (OT6)

Theme 2: Issues with the use of the VH application within stroke. Key issues concerning the use of the VH application were identified from the therapists' perspectives.

Patient-centred issues:

Therapists, however, felt that patients with significant cognitive, visual, or perceptual impairments would be unable to engage with the generic VH in a meaningful way, and that it may be potentially confusing and difficult to relate this to their own home.

"I think there's a limited group of patients it could be used with. I think a lot of our patients from a stroke perspective, with especially those with cognitive problems, would find it very difficult to understand." (OT2)

Age and computer literacy were viewed as potential barriers to engagement, with some therapists feeling that the application was more suited to younger patients.

"The majority of patients we have are elderly, and technical things like these just totally frighten them. So I think the concept of this would work perhaps better with younger patients." (OT10)

Nonetheless, there was a sense that the therapists would be willing to trial the application with a range of patients to explore these potential engagement issues.

"... you've got to be open-minded and try it with a range of patients and different ages, level of disability, and so on." (OT3)

Resource-based issues:

Time and resources were seen as important factors potentially limiting the use of the VH within stroke services, and the need for cost-effectiveness and ease of use was identified. The IT systems and equipment typically available on hospital wards were also viewed as potential barriers to implementation.

"... costs are always a problem. It needs to work on the technology we have, which isn't brilliant. There isn't money to be able to go out and buy new assessments and tools. If it takes 5 minutes to do three steps forwards, which looks like it might on our computers, the patient isn't going to engage with it. They're just going to find it frustrating." (OT7)

Potential threat to practice:

Some therapists were concerned that the VH application could be used to replace the practice of home visits, and that this could threaten a central aspect of their role as a therapist.

"The reason we are doing home visits is to replicate them in their home environment, so the virtual environment won't do that." (OT12)

“ . . it's doing us out of what our role is with patients in their own home, and support we give them in that environment.” (OT3)

It was also suggested that using the VH to raise awareness of issues and risks might not ensure that any appropriate action is then taken:

“ . . people can understand the problem, but they don't necessarily act on it.” (OT12)

Theme 3: Modifications and usability. A number of potential modifications were identified to improve the clinical relevance of the VH in stroke services.

It was felt that more furniture and household objects were required in the rooms, because some of the key practical issues identified on home visits relate to falls hazards (such as from general clutter, rugs, children and pets).

“Houses aren't neat and tidy like this. Some are, but some patients you go and it's just clutter, you know, you'll have lots of clutter. And I mean, I suppose it, you know, how honest are people going to be about that? Some people might be and say 'oh, you can't get round', but you'd need other objects, this is all quite spacious.” (OT2)

Therapists also felt that the VH was not representative of most patients' homes because it was all on one level. The addition of steps and stairs was felt to be important, as well as features such as uneven ground outside and ramps.

“I think you'd have to have stairs there probably as a rule or internal steps as well. Narrow little galley kitchens, all those little nightmares we've got. Spiral staircase with no rail.” (OT3)

For patients with visual difficulties, it was felt that the screen size needed to be larger. The décor of the VH was also identified as a potential problem in this context, in particular the contrast of the colours and patterns used.

“I can see it clearly, but people that have any visual problems whatsoever, it blends into the chair and into the wallpaper.” (OT9)

“Lots of patterning, for the people with perceptual problems, it could be a bit tricky.” (OT5)

It was felt that the VH could be improved by varying the style and contents depending on the patient's home; for example, different types of home, layout and items of furniture.

“It would be worth maybe having the option of different types of cooker, microwave . . . you need the option of having different types of heating, gas fire, electric fire.” (OT2)

“ . . we see all sorts of different properties, very cluttered ones or unclean and unkempt ones, so I guess the more scenarios you could cater for the better.” (OT5)

Improving the software's usability was also identified as a priority. In particular, easier controls would be needed to navigate through the VH, and problems such as the avatar becoming 'stuck' in walls, and the changing perspectives that the users had as the avatar, would need resolving.

“I think it can be a bit confusing, when you're going through doors and the walls come back in front of you and things, that's a little bit confusing and can be a little bit difficult to find your way around.” (OT8)

Patient and stroke survivor interview findings

Interviews conducted with hospital patients and stroke survivors from the community were analysed together. The emergent themes and sub-themes from the analysis are described below, accompanied by example quotations, and are summarised in Table 2.

Theme 1: Patient engagement. Both the patient and stroke survivors were, on the whole, able to engage with the VH and perceived it to be a useful visual aid to facilitate discussions about their own home environment and help plan for discharge.

“You can look at [it] and say, ‘Well, how would you cope with that? – How are you going to cope with heating? –How are you going to cope with getting to the loo or whatever?’. . . It is always a good idea to have a picture; a picture paints a thousand words.” (Stroke survivor 1)

Both groups felt that the VH could help to prompt their memory about what their own home was like, and would be a good visual aid to facilitate discussions with therapists about potential hazards.

“They can, like, discuss with the patient, you know, alright you have got your favourite rug but it can be a danger. You can have it one day but not at the moment, you know, so get it out of the way.” (Patient 2)

Both the groups felt that although the VH did not reflect what their own homes were like, the important basic elements that are common to all homes were nonetheless represented, such as furniture, fixtures and fittings.

“I think all houses are more or less the same aren’t they?” (Patient 5)

It was felt that the VH could help to increase patients’ awareness and insight into the potential risks and hazards within their own homes. Some were also able to identify specific issues relevant to themselves and how these might be addressed.

“Well, it has made me be aware, yes more aware, because I wasn’t even thinking about the safety aspect at all really, so it has made me more aware.” (Patient 5)

“I’d put a few more handles in the bath to get in and out and definitely one in the toilet area, to give that little bit more confidence, safety.” (Patient 3)

Theme 2. Modifications and usability

Modifications:

Some important features were felt to be missing from the VH that would make it more relevant. For example, the VH was all based on one level and, as with the therapist interviews, patients and stroke survivors suggested that stairs should also be included, as well as more furniture in each of the rooms.

“I suppose it is similar except it hasn’t got much in it. Well, I would put more chairs in. I’d have more stuff in, a lot more in.” (Patient 1)

The stroke survivors living at home also felt that it would be beneficial for the software to be made interactive.

“I think in the kitchen you need to put a few things on the units that people can pick up.” (Stroke Survivor 4)

As with the therapist interviews, patients and stroke -survivors felt that the de´cor of the VH was too bold and could potentially be disorientating to others.

“Bit too ‘busy’, yeah. I think plain walls would be better for people.” (Stroke Survivor 3)

Usability:

While half of the patients in hospital had not previously used a computer, this was not generally seen as a barrier to the use of the software application, particularly if support was available:

“It wouldn’t put me off, if I had somebody to, you know, explain better and train me about how to use it.” (Patient 3)

The stroke survivor group was more experienced in the use of computers, yet they felt that use of this technology might be an obstacle for others, especially older people.

“I wouldn’t have a problem with computers myself, but I think that is an area that needs to be carefully considered, because of generation gaps and a large, as you know, large numbers of stroke patients are elderly.” (Stroke Survivor 2)

Some patients and stroke survivors who attempted to use the VH felt that it was difficult to use and control and, as with the therapist interviews, some suggested that the screen size should be made larger:

“It’s very difficult to manipulate . . . that the avatar in and out of the rooms, but I suspect a lot of that is practice.” (Stroke Survivor 1)

Discussion and implications

This was an initial scoping study that sought to explore therapist and patient perspectives concerning the potential utility of a VH application as a tool to support patient discharge after stroke. The interview findings indicate that the therapists, patients and stroke survivors were willing to engage with the VH and felt that, with some caveats, this would be an acceptable technology to support discharge.

The visual cues provided by the VH were seen as helpful in prompting discussions about the patient’s own home, in order to address issues relevant to the individual, such as identifying potential safety concerns. It was also felt that the VH could be used to help people visualise items of assistive equipment that might be required (such as commodes, hospital beds and grab rails), and what impact these may have on the home in terms of installation, space requirements and storage. This supports previous findings (Atwal et al., 2013) about the use of virtual technologies in discharge planning. Therapists felt that there was potential to utilise the VH to assess patient insight into safety risk. It was suggested that therapists could explore particular scenarios with patients in order to assess how they would respond, and discuss the consequences of choosing certain actions. Both the patient and stroke survivor groups were able to demonstrate engagement with the VH by making comparisons with their own homes and by identifying potential safety risks.

Although the literature suggests that there is considerable variation in the numbers of patients who actually receive a home visit prior to discharge (Drummond et al., 2012), some therapists expressed concerns that the VH application could be used to replace the need for home visits. It was felt that this could then diminish a core aspect of their role. This issue was also identified by Atwal et al. (2013) and reflects concern within the wider rehabilitation literature that VR could be perceived as a potential threat to practice (Rizzo and Kim, 2005). However, parallel positive attitudes towards technology have also been reported from

therapists who believed that technology could add value to their role (Schaper and Pervan, 2007).

Some therapists also felt that patients with significant cognitive, visual, or perceptual impairments would not be able to engage with the VH and relate it back to their own home. It is acknowledged that none of the patient and stroke survivor participants in this study had any significant cognitive, visual, or perceptual impairments, and further investigation will therefore be required to determine patient engagement and acceptability in relation to these. However, Whitehead et al. (2014) reported that therapists were similarly cautious about completing actual home visits with these patient groups due to the same concerns about patients' ability to understand the aims or cope with the demands of a home visit. Where direct patient engagement with the VH may not be possible due to such impairments, there would nonetheless be scope for its use with the patients' family members or carers in supporting the discharge process.

Therapists and stroke survivors felt that age was a potential barrier to engagement with the VH, as it was felt to be more suited for use with younger patients who may have more experience with computers. While the achieved patient and stroke survivor samples did lack some variation, (for example, all were white British) we were able to capture a broad range of ages and include patients with no previous computer experience. Interestingly, the patient group felt that age was less of a barrier to engagement than did the therapists or stroke survivors, especially if used in a supported session with a therapist. Within wider stroke rehabilitation, older adults with limited previous experience with computers have found VR and gaming to be enjoyable as part of their rehabilitation (Alklind Taylor et al., 2009; Casserly and Baer, 2014; Wingham et al., 2015). It is therefore important that assumptions regarding age are not used as the basis to determine engagement with technology (Threapleton et al., 2016). Regarding the achieved sample sizes, the therapist and stroke survivor groups were also slightly smaller than intended. This was due to a relatively narrow timescale in which the interviews could be completed. As the stroke survivors were all living with a partner, we also could not capture the perspectives of those returning home from hospital without the support of an immediate family member/partner. This will need to be addressed in a future study.

Equipment provision was identified as a potential barrier to the use of VR within stroke services. It was felt that hospitals would not be able to support the use of the software due to inadequate access to updated computer systems. Several usability issues were also identified with the current configuration of software and hardware for the VH. For example, both therapists and patient groups found some of the navigation controls to be difficult and felt that a degree of training would be useful. The use of low-cost devices, such as touchscreen tablets, on which to display the VH could potentially overcome issues with software compatibility with hospital systems and improve navigation. Tablet devices would also offer the advantage of portability for ease of use in a ward environment. However, as comments were also made regarding the need for a larger screen size, the potential use of tablets requires further investigation.

Although not a primary aim of the interviews, a number of potential modifications were identified for the development of the VH application. For example, in order to increase its clinical relevance, it was suggested that the VH should contain more general household objects, as well as steps and stairs. The patterns and colours used for items in the rooms, such as the wallpaper and carpets, were also felt to be distracting and would need to be changed, especially for those with perceptual or visual impairments. Accordingly, modifications have since been made to reduce the boldness of some of the patterns and colours used. The perspective from which the user viewed the avatar was also felt to be disorientating, and this has since been modified to represent the actual point of view of the avatar (instead of viewing the avatar as they navigate the VH). The next phase of the

research will build on these initial findings and modifications. Further exploration of the ideal content and function of the software, including focus on which items of assistive equipment and which home configurations should be included in the VH application, will be fundamental to the future implementation and success of the application as an occupational therapy tool.

Conclusion

This research demonstrates the potential for wider use of VR technologies within occupational therapy and stroke rehabilitation, and confirms that further development and investigation is warranted. Although several software issues need to be addressed, such as usability and the need to include assistive equipment and different home configurations, the VH has the potential to provide a means of ward-based assessment prior to discharge that is both practical and cost-effective. The goal will be to develop the technology to a standard at which its effectiveness can be determined in comparison with other approaches, both within stroke care and more broadly. The next phase of the research will be to conduct feasibility and pilot testing with an improved version of the VH application in the clinical setting.

Key findings

- The VH was acceptable to both therapists and patients as a potential tool to facilitate discharge after stroke.
- Practical modifications were identified to direct future development and research.

What the study has added There is potential for the wider use of VR technologies for discharge planning within stroke rehabilitation. VR may enable a standardised level of intervention to be provided to support patient discharge.

Acknowledgements

The authors would like to thank the occupational therapists, patients and community stroke survivors for participating in the interviews. They would also like to acknowledge Emily Birks and Alexandra E. Smith for their role in collecting data, and Dr Nikola Sprigg and Professor Penny Standen for their guidance as part of the wider research team.

Research ethics

Ethical approval was obtained from the Research Ethics Committee (NRES Committee East Midlands – Leicester; REC Ref: 13/EM/0241), June 2013.

Declaration of conflicting interests

The authors confirm that there is no conflict of interest.

Funding

This research was funded by the Stroke Association (ref: TSA SRTF 2013/01) and Nottingham Hospitals Charity and NUH Department of Research and Development – Pump Priming Award.

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